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FORSCHUNGSZENTRUM

System Monitoring: LLview

November 27, 2015 | Carsten Karbach and Julia Valder

Content

Part I: Overview

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Motivation

- Is my job running?
- When will it start?
- How is the current load?
- How is my job placed?

```
Id                      Owner      Submitted   ST PRI Class        Running On
----------------------- ---------- ----------- -- --- ------------ -----------
juqueen1c1.192822.0     curioni    11/7  11:22 I  50  systemall
juqueen1c1.192824.0     curioni    11/7  11:23 I  50  systemall
juqueen1c1.192825.0     curioni    11/7  11:23 I  50  systemall
juqueen1c1.192835.0     curioni    11/7  13:37 I  50  systemall
juqueen4c1.82115.0      hhh150     11/4  19:13 I  50  m016
juqueen1c1.191375.0     hdu180     11/4  23:25 I  50  m008
juqueen1c1.192826.0     jzam1159   11/7  11:27 I  50  m008
juqueen1c1.192844.0     jhpc0902   11/7  14:00 I  50  m008
juqueen2c1.190024.0     pra08801   11/3  04:31 I  50  m004
juqueen4c1.81936.0      jias1304   11/3  09:49 I  50  m004
juqueen4c1.81937.0      jias1304   11/3  09:49 I  50  m004
juqueen4c1.81938.0      jias1304   11/3  09:49 I  50  m004
juqueen4c1.81939.0      jias1304   11/3  09:50 I  50  m004
juqueen2c1.190675.0     jzam0420   11/5  13:42 I  50  m004
juqueen1c1.190354.10    hwu081     11/3  12:22 I  50  m002
juqueen2c1.190857.0     jiff4605   11/6  10:50 I  50  m002
juqueen2c1.190971.0     hhh073     11/7  10:11 I  50  m002
juqueen2c1.190972.0     grs30007   11/7  10:12 I  50  m002
juqueen3c1.79205.0      jinb3309   11/7  11:56 I  50  m002
juqueen1c1.192846.0     jzam0435   11/7  14:18 I  50  m002
juqueen4c1.80786.3      hbo273     10/28 11:49 I  50  m001
juqueen2c1.189769.2     hbo381     11/1  23:48 I  50  m001
juqueen1c1.190640.0     hch02r     11/4  07:03 I  50  m001
juqueen1c1.190643.0     hch02r     11/4  07:03 I  50  m001
juqueen1c1.190642.0     hch02r     11/4  07:03 I  50  m001
juqueen1c1.190641.0     hch02r     11/4  07:03 I  50  m001
juqueen1c1.190647.0     hch02r     11/4  07:03 I  50  m001
juqueen1c1.190646.0     hch02r     11/4  07:03 I  50  m001
juqueen1c1.190645.0     hch02r     11/4  07:03 I  50  m001
juqueen1c1.190644.0     hch02r     11/4  07:03 I  50  m001
juqueen1c1.190648.0     hch02r     11/4  07:03 I  50  m001
juqueen3c1.78904.7      jikp0501   11/5  09:39 I  50  m001
juqueen2c1.190615.0     hhh045     11/5  09:55 I  50  m001
juqueen2c1.190617.0     hhh045     11/5  09:58 I  50  m001
juqueen4c1.82192.0      hhh045     11/5  14:42 I  50  m001
juqueen4c1.82197.0      hhh045     11/5  15:48 I  50  m001
juqueen2c1.190713.0     jikp0403   11/5  16:27 I  50  m001
juqueen2c1.190715.0     jikp0403   11/5  16:35 I  50  m001
juqueen2c1.190716.0     jikp0403   11/5  16:41 I  50  m001
juqueen1c1.191700.0     talahde    11/5  16:47 I  50  m001
juqueen2c1.190718.0     jikp0403   11/5  16:48 I  50  m001
juqueen2c1.190723.0     jikp0403   11/5  16:56 I  50  m001
juqueen1c1.191701.0     talahde    11/5  16:59 I  50  m001
juqueen2c1.190725.0     jikp0403   11/5  17:11 I  50  m001
--More--
```

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Why system monitoring?

- For administrators
  - Global overview of system utilization
  - Throughput optimization
  - Batch system configuration optimization
  - Adaptive change of scheduling parameters
- For users
  - Controlling own running and waiting jobs
  - Planning job submissions
  - Use of idling resources

$\Rightarrow$ LLview

  - Compact display of all usage data in one window
  - Easy access to system's status data
  - Interactive display for linking information
  - Open Source (BSD-style)
  - Available for all JSC systems

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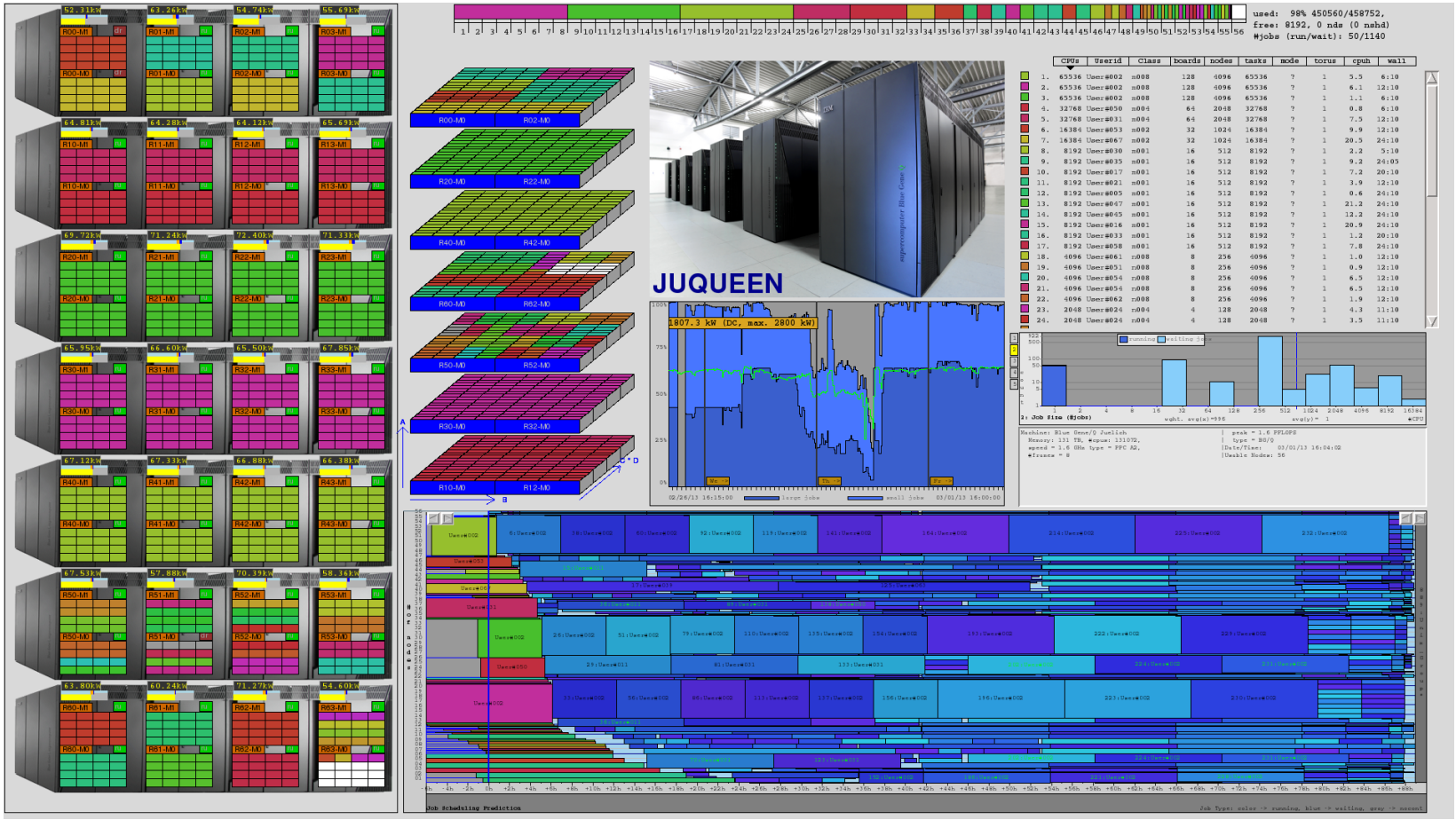
LLview

→ Visualizes supercomputer status on a single screen



Source: Screenshot LLview for JUQUEEN

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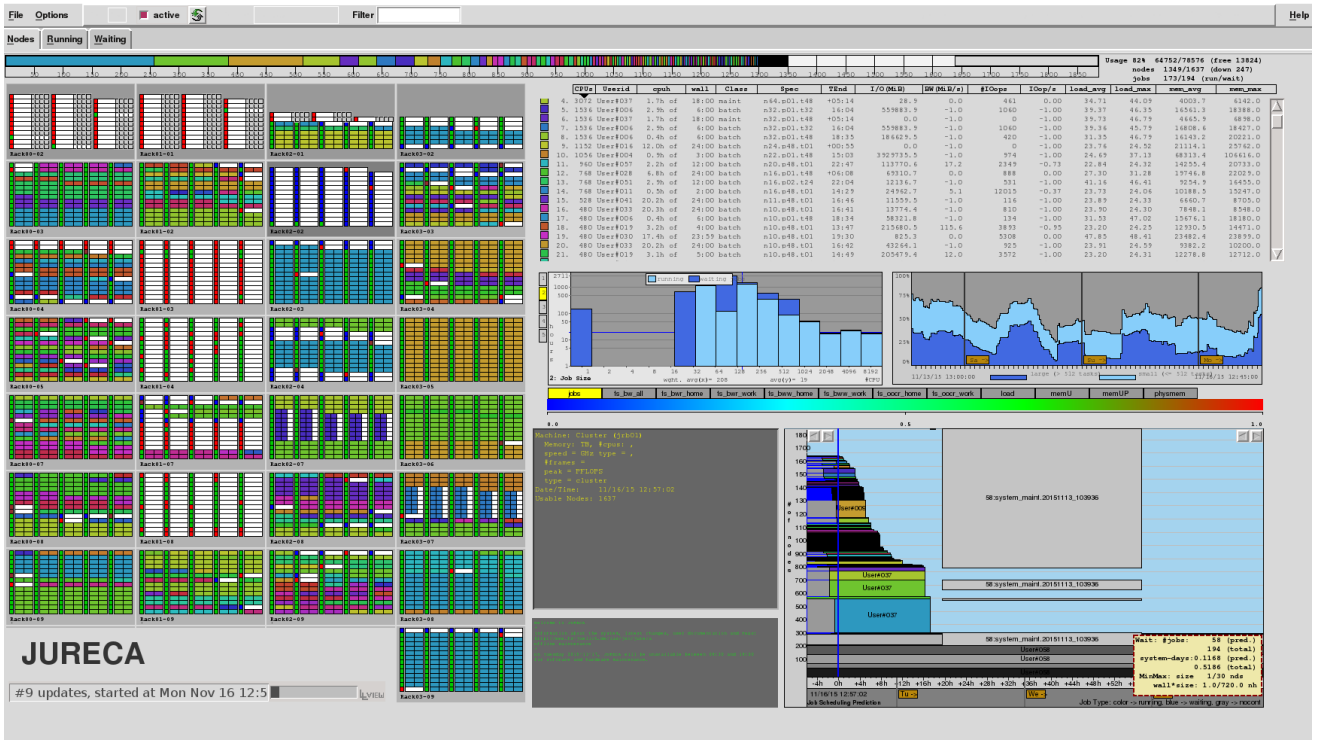
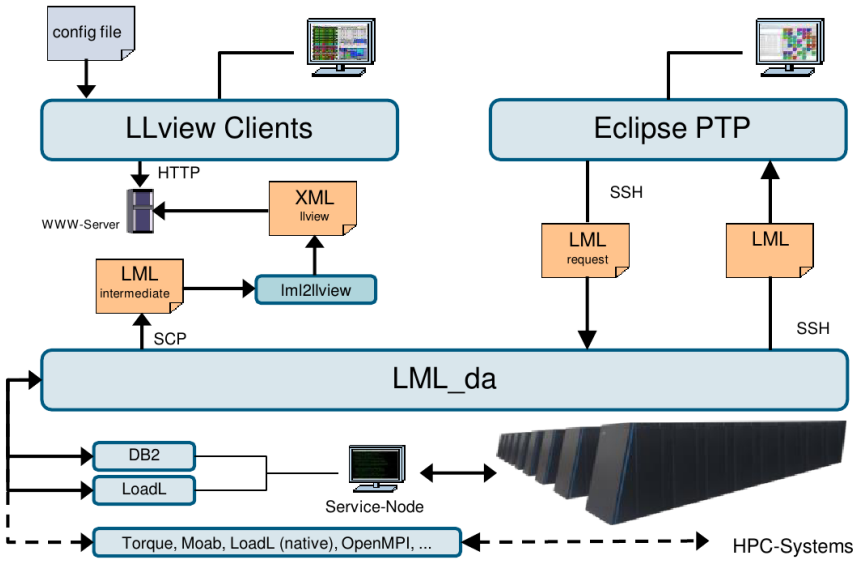
LLview Example: JURECA

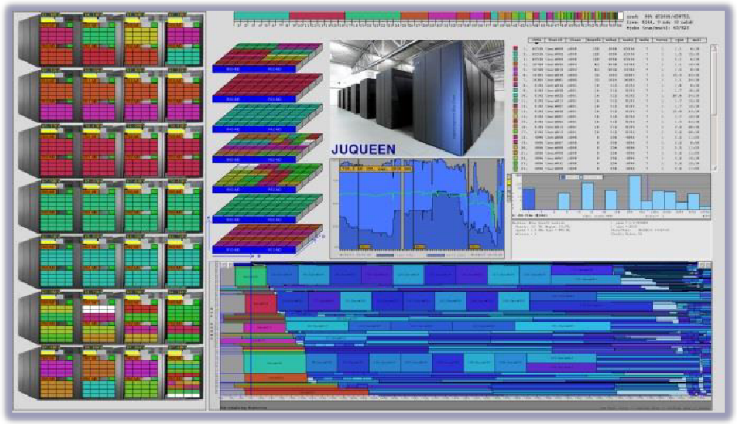


Source: Screenshot LLview for JURECA

- High fragmentation
- Heterogeneous
- Batch System: SLURM
- Ongoing development

LLview Architecture





- Client-Server architecture, LML_da as backend
- Clients: Perl-Tk, PTP, Webinterface
- Platform independent: works on Windows, Mac and Linux
- Wide range of supported batch systems,
  minimal effort for extension
- Minor performance impact on monitored system,
  only **central batch** system is queried

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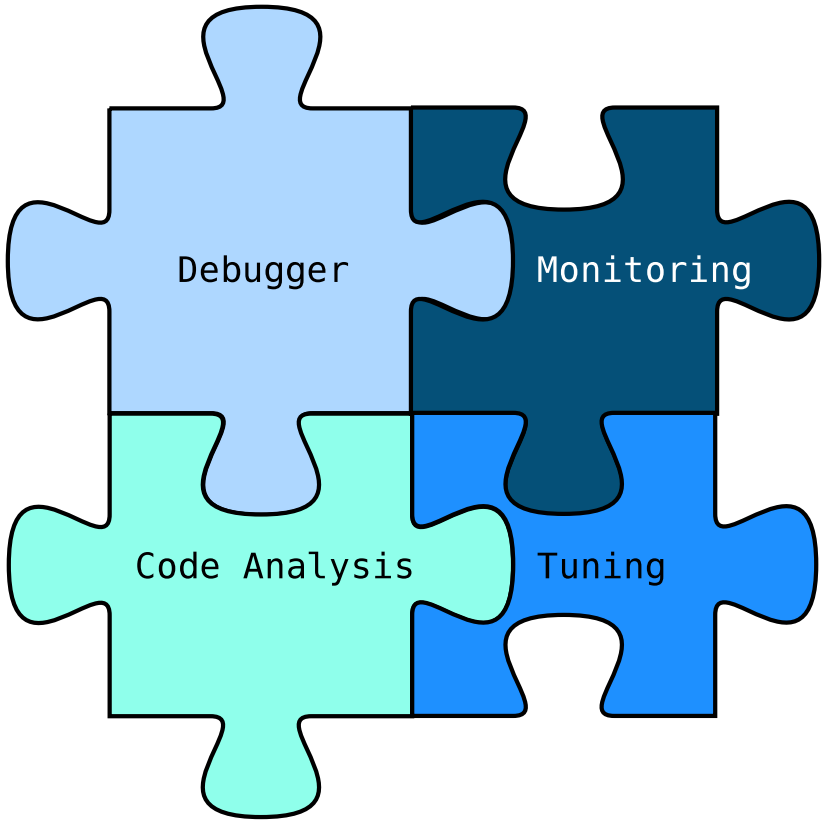
PTP – Parallel Tools Platform

What is PTP?

- **IDE** for parallel application development
- Based on **Eclipse**
- **Open-source** project
- Developers: IBM, U.Oregon, UTK, Heidelberg University, NCSA, UIUC, JSC, ...



- **JSC-PTP tutorials** → `http://www.fz-juelich.de/SharedDocs/Downloads/IAS/JSC/EN/PTP/JSCPTPJuqueen.html`
- **PTP Download** → `http://www.eclipse.org/downloads`, *Eclipse for Parallel Application Developers*

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How to start the LLview client?

Option 1: via SSH

```
ssh -X karbach@jureca
llview
```

Option 2: Webinterface

- Screenshots of LLview updated every minute
- Link: `https://llview.fz-juelich.de/LLweb/juqueen/Image.html`
- Access secured by JSC webservice accounts
  - register at dispatch
  - request access to LLview via jsc-dispatch@fz-juelich.de

Option 3: Local installation

- Download and install the LLview client locally

Part II: Components

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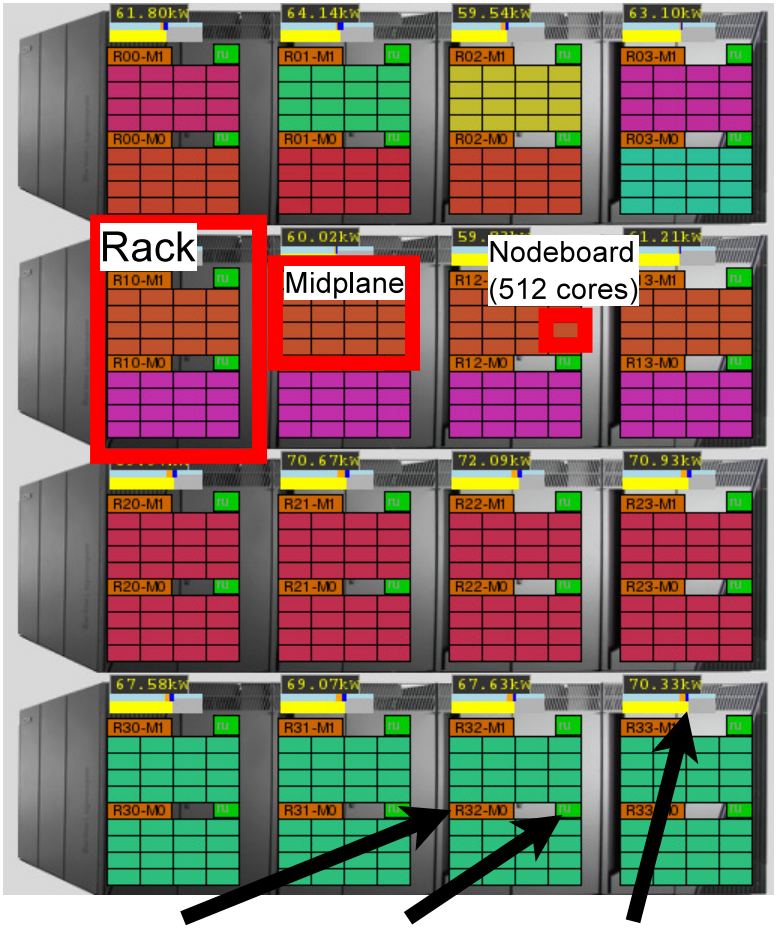
Node display



- Compute resources
- Job distribution
- White = Idle, Colored = running
- Node name
- Node status
- Level of detail

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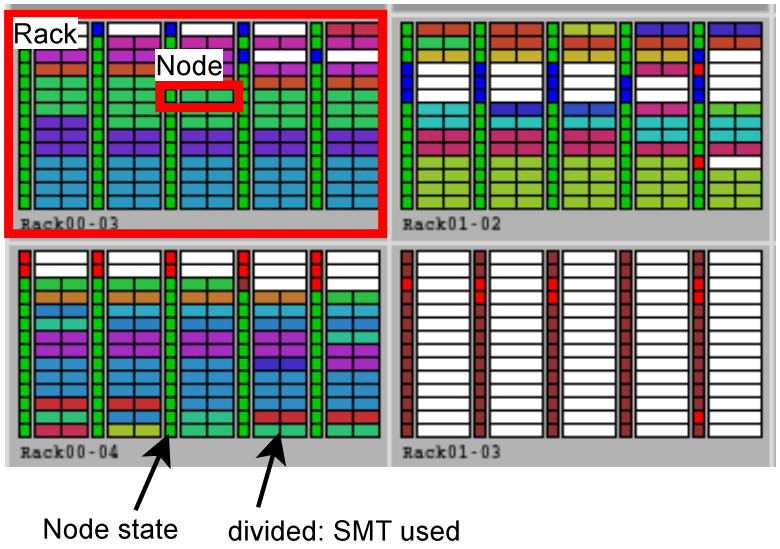
Node display



- Compute resources
- Job distribution
- White = Idle, Colored = running
- Node name
- Node status
- Level of detail

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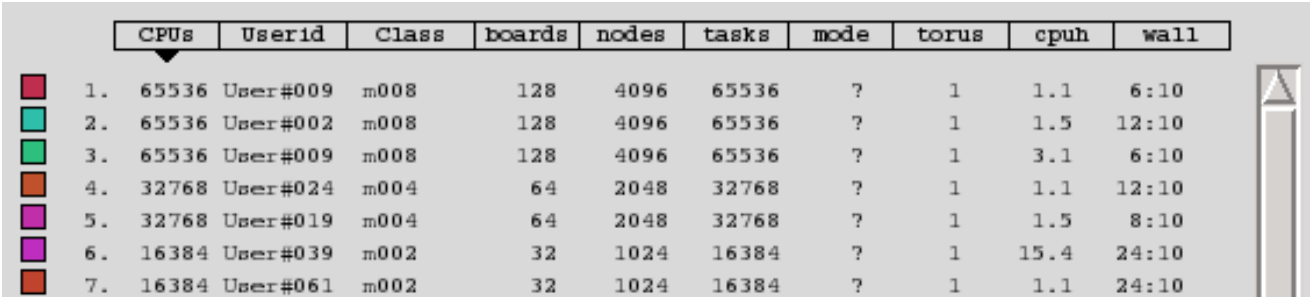
Job list



	CPUs	Userid	Class	boards	nodes	tasks	mode	torus	cpuh	wall
1.	65536	User#009	m008	128	4096	65536	?	1	1.1	6:10
2.	65536	User#002	m008	128	4096	65536	?	1	1.5	12:10
3.	65536	User#009	m008	128	4096	65536	?	1	3.1	6:10
4.	32768	User#024	m004	64	2048	32768	?	1	1.1	12:10
5.	32768	User#019	m004	64	2048	32768	?	1	1.5	8:10
6.	16384	User#039	m002	32	1024	16384	?	1	15.4	24:10
7.	16384	User#061	m002	32	1024	16384	?	1	1.1	24:10

- List of running jobs
- Most important attributes per job
- Sort by clicking on the column header
- Identifying color next to each job entry

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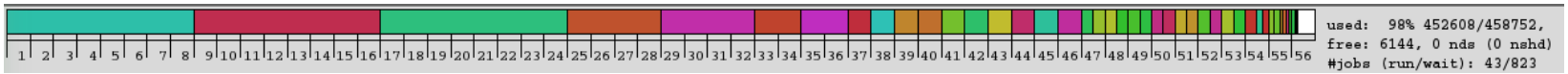
Usagebar



- Summary of system load
- Job size decreases from left to right
- White space shows idling resources
- Unit for JUQUEEN is midplanes, for JURECA nodes

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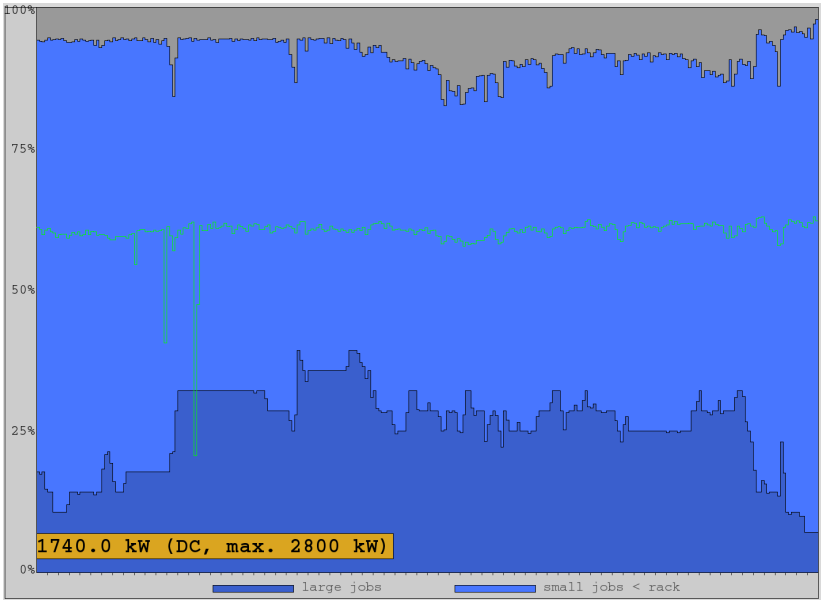
History



- 3-day load history
- Often divided into small and large jobs
  JUQUEEN (1 midplane), JURECA (512 tasks)
- Mouse-Over for detailed information
- Green line for special history value
  JUQUEEN (power)

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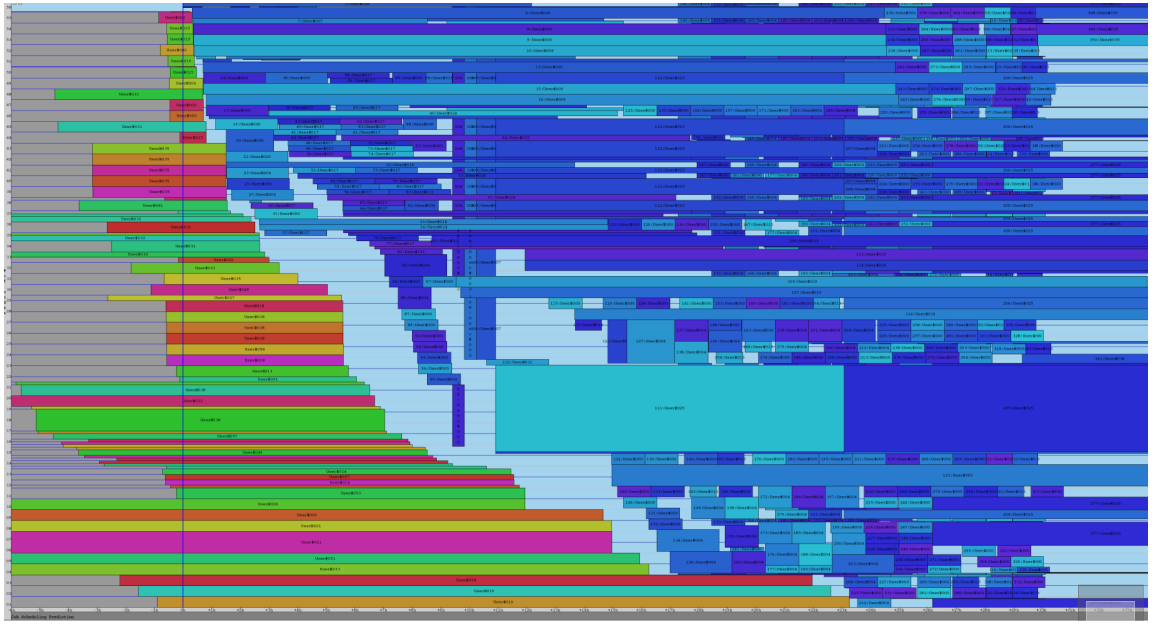
Prediction

- Scheduler prediction based on submitted jobs
- Wall clock limit as job duration
- Blue = predicted job, Colored = running jobs
- Each rectangle one job,
  x-axis = time, y-axis = nodes/midplanes
- Use of idle times
- More transparent scheduling
- JUQUEEN: self-implemented, JURECA: use of SLURM's prediction



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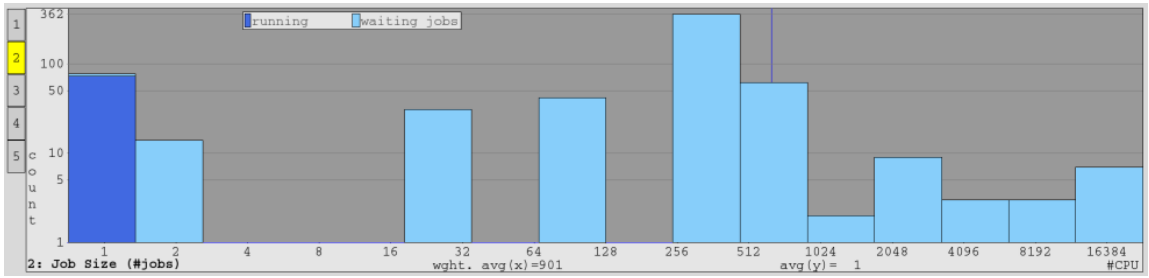
Statistics

- Statistic overview on system status
- Histograms on job size, wait time, queue load
- Highly configurable, define x-axis/y-axis domain, logarithmic/linear scale
- Overlayed diagrams for waiting/running jobs



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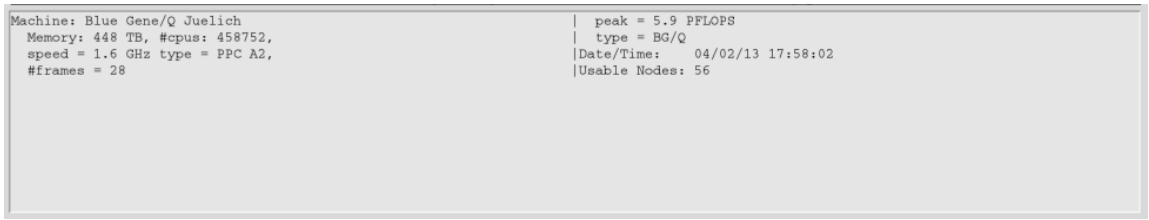
Infobox



- Shows details on the currently focused object
- Mouse-Over triggers to display detailed data on the focused job/node/system/diagram

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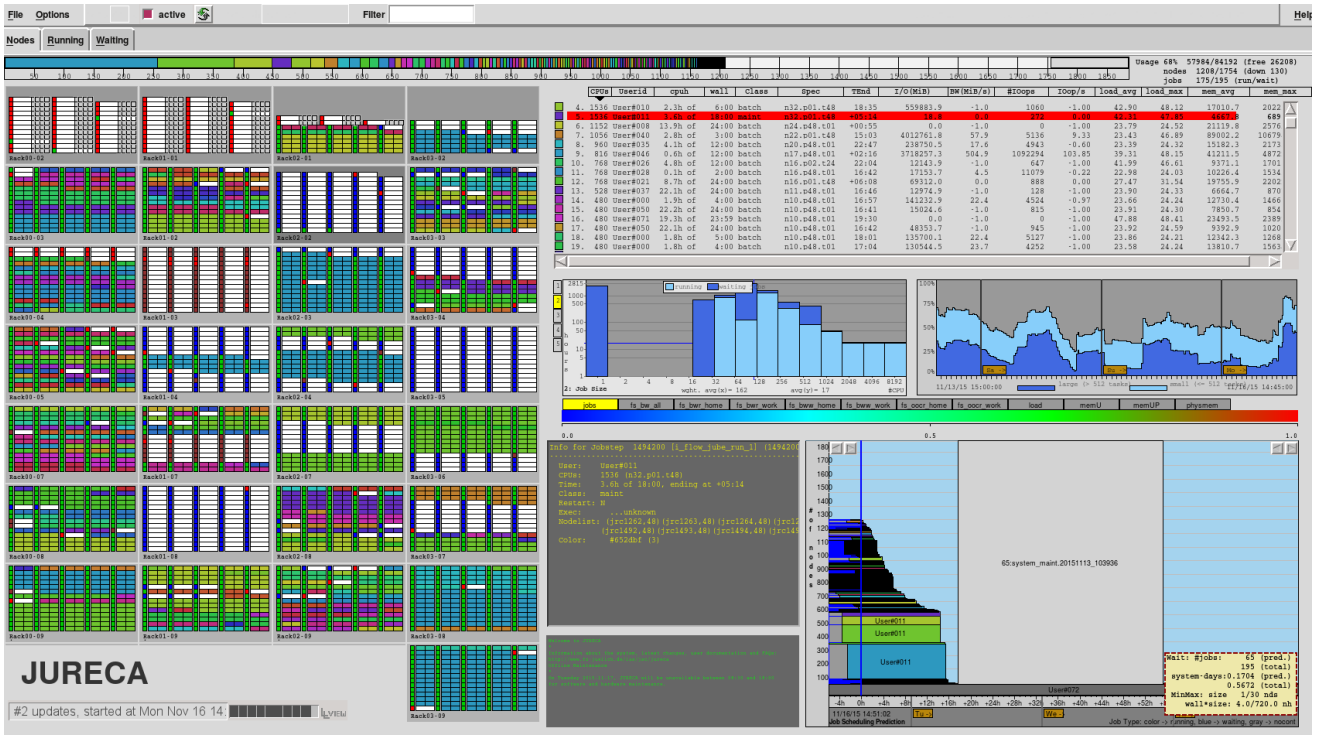
Interaction

- **Mouse-Over** jobs highlights job rectangles for the selected job in all components and shows details on the job in infobox



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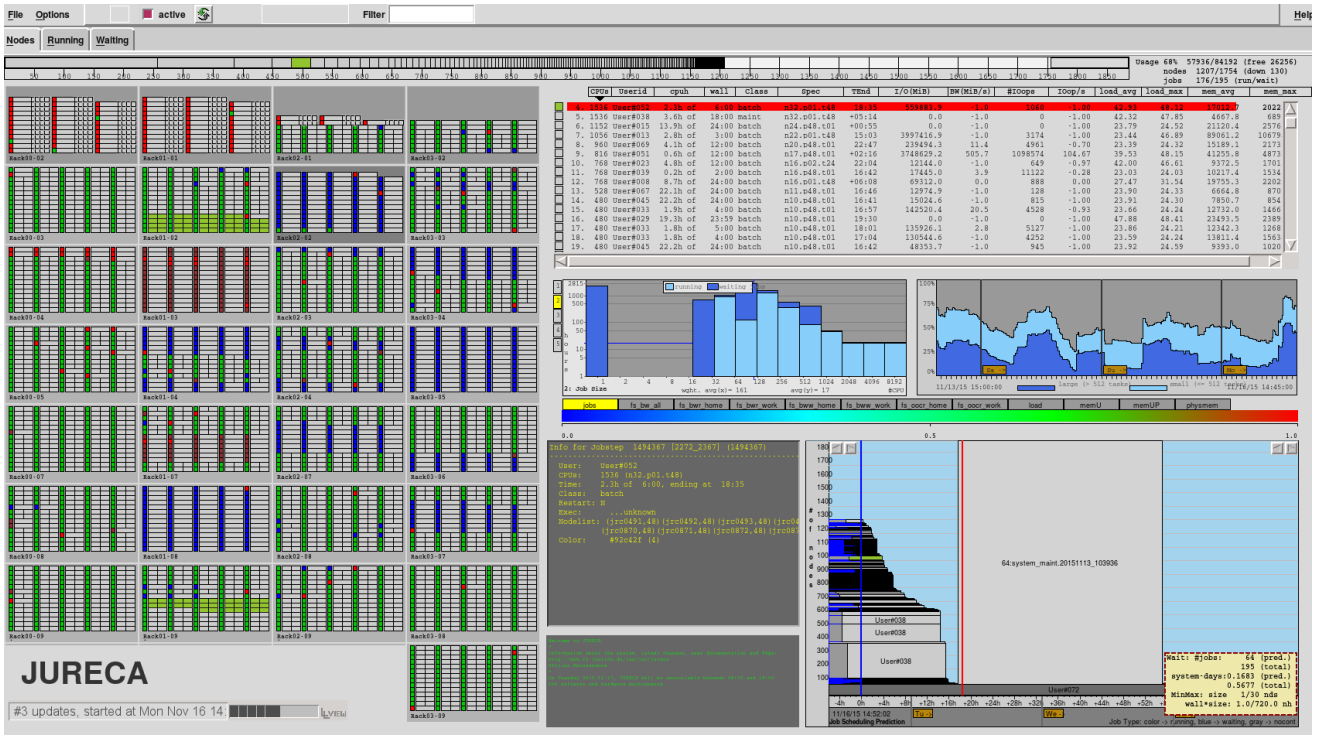
Interaction

- **Mouse-Over** jobs highlights job rectangles for the selected job in all components and shows details on the job in infobox
- **Mouse-Down** (Hold) removes color for all other jobs, only the selected job is colored



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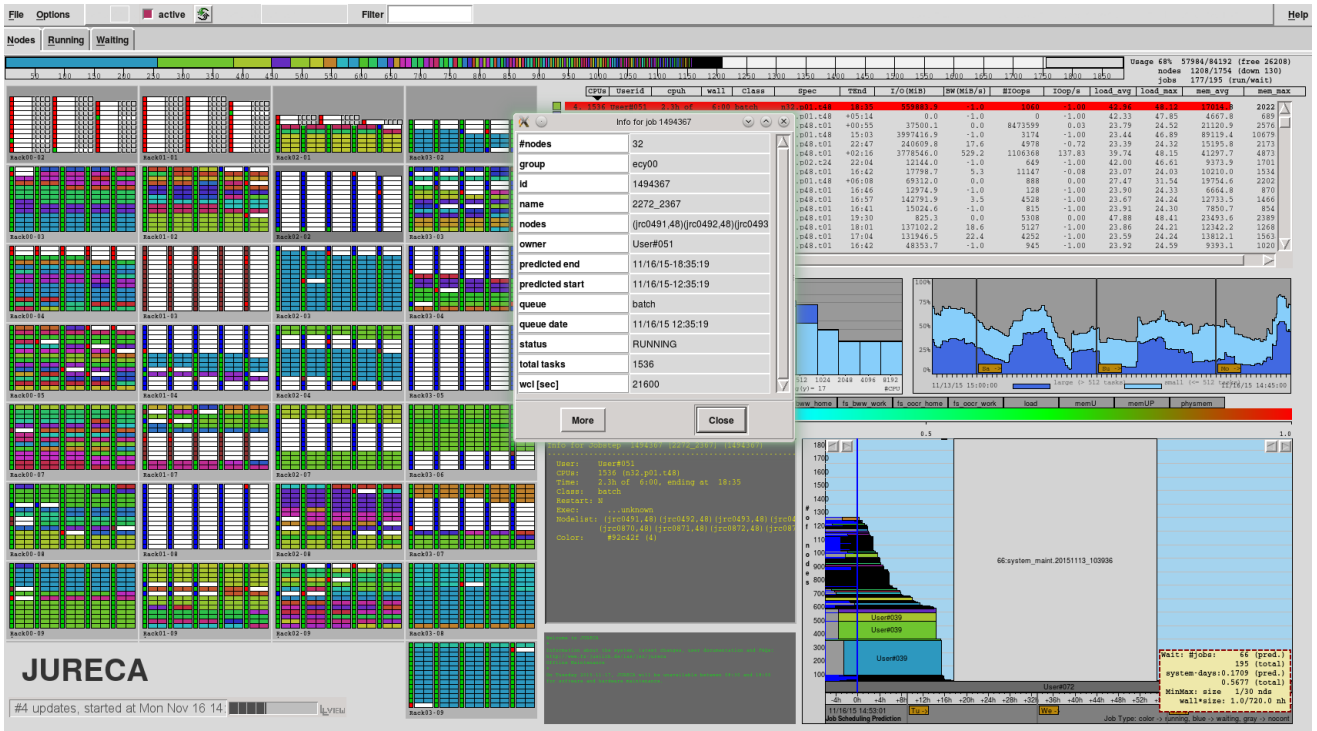
Interaction

- **Mouse-Over** jobs highlights job rectangles for the selected job in all components and shows details on the job in infobox
- **Mouse-Down** (Hold) removes color for all other jobs, only the selected job is colored
- **Double-Click** show job detail dialog
- Mouse interaction helps to link the information shown in all components



Part III: Customization

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LLview

- LLview is **highly customizable** due to numerous options
- Settings specific to HPC system type
- Start through option menu of main window or `Ctrl+o`
- Most options have **immediate effect** in the main window
- Some will become active at next start of LLview (e.g. *Data source* change)
- LLview layouts use **absolute** positioning
- You can use arrow keys to add/subtract one on numeric values
- Use Page up/Page down keys to add/subtract a bigger step on numeric values

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LLview configuration files

Three configuration file locations (highest priority first):

1. anywhere on your file system passed to LLview with the `-rcfile` option
2. local `.llview.rc` configuration file in current directory or in HOME directory of the user
3. `llview.rc` in the installation directory of LLview. This file contains the system-wide settings

- Configuration files contain all LLview options
- You can change them in any text editor or via the LLview Option window

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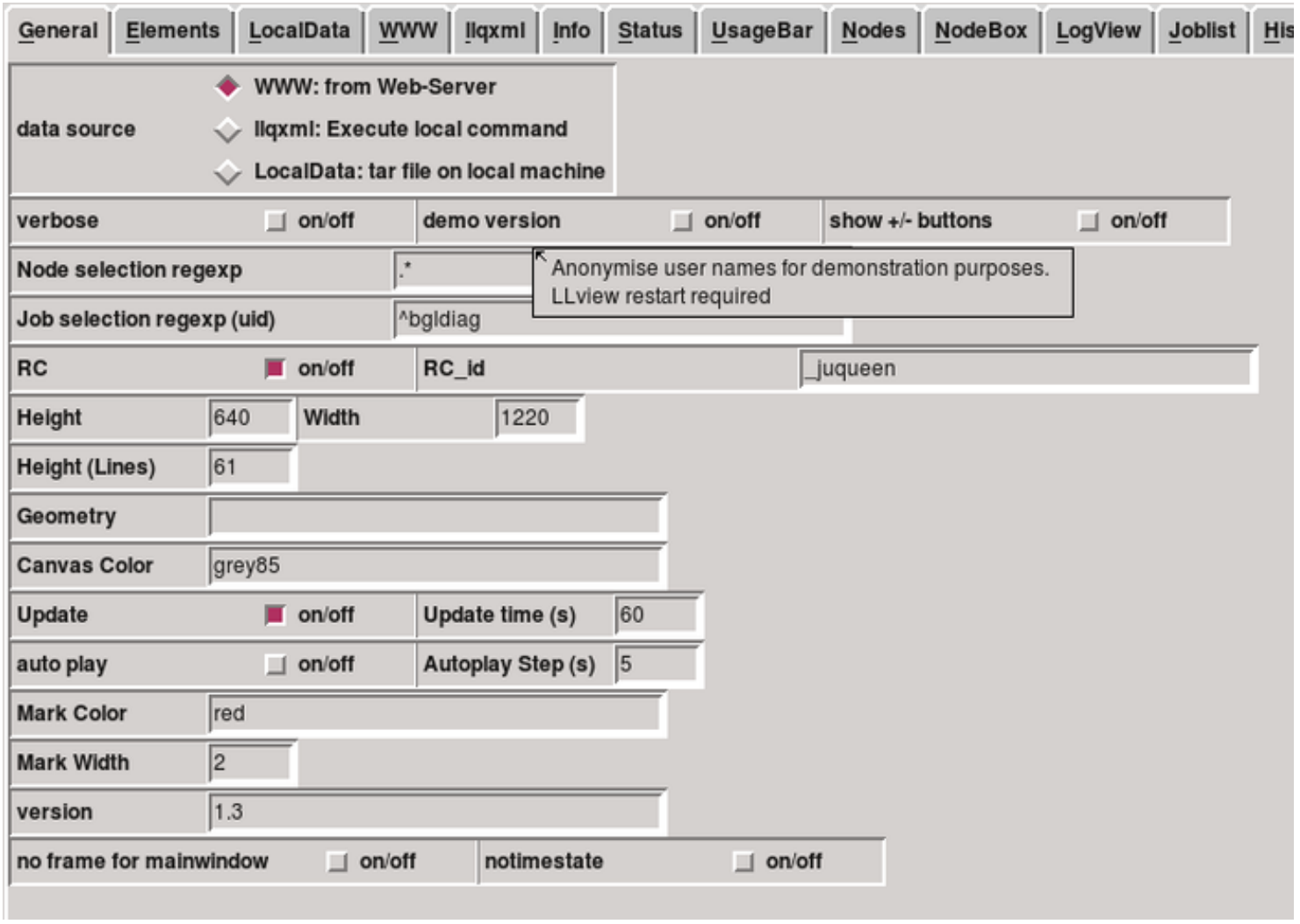
LLview options



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General Options

- *General* options for the main window
- Choose your preferred data source (*Web-Server*, *LocalData* or *local command*)
- *demo version*: anonymise usernames (for public display)
- *Job selection regexp*: filtering jobs by regular expressions
- Customize *Height* and *Width* of the main window
- *Canvas Color*: background, *Mark Color*: color for marking job in job list
- Choose time until next update
- *auto play* lets LLview mark different jobs automatically (for public display)

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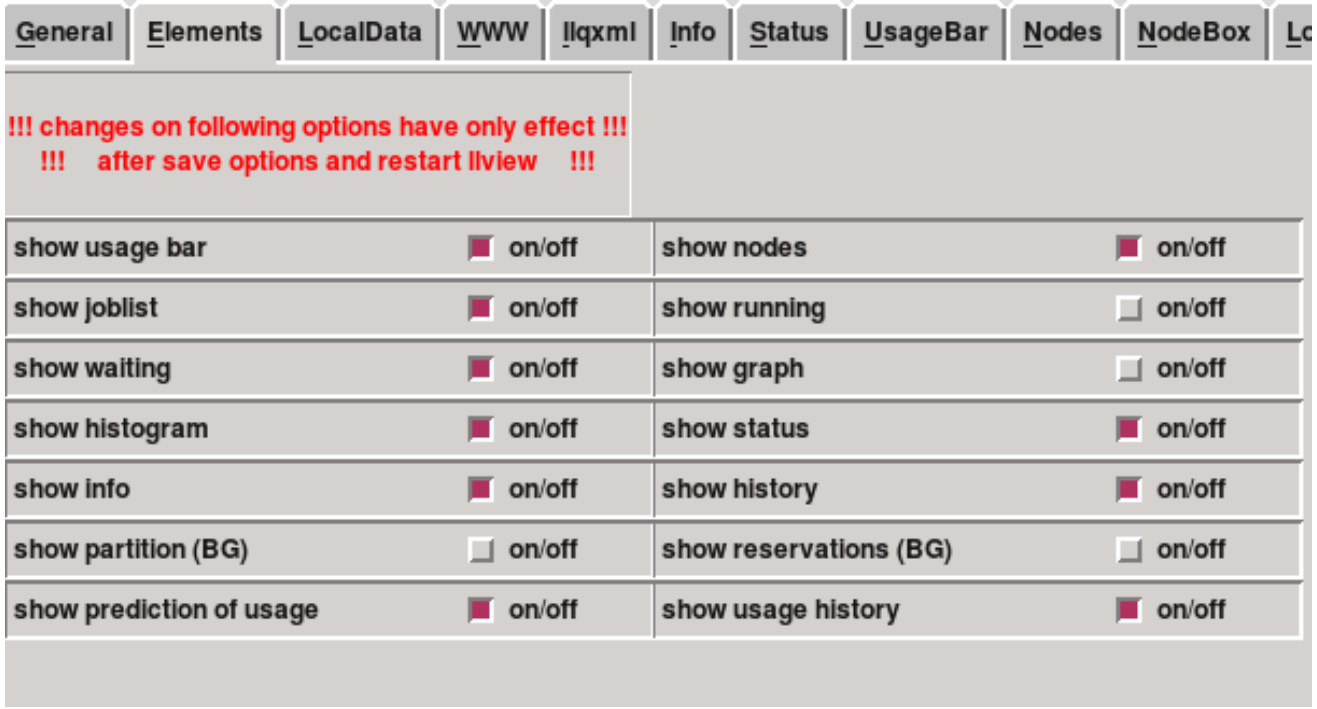
LLview Element options



- Choose, which Elements to show
- For end users: components like *joblist*, *info*, *nodes* and *prediction* etc.
- Changes take effect after **restarting** LLview

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LLview Node options

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Node Options

- Customize *Height*, *Width* and *Margins* of the node display
- Logical node view available for BG systems e.g. JUQUEEN $\Rightarrow$ *Twin View* places adjacent midplanes next to each other in torus network
- Options for the *Twin View* are available in a new option subfolder $\Rightarrow$ *Log View*
- *Node attr.*: show scalar data e.g. temperature or power usage
- Show logo or site name

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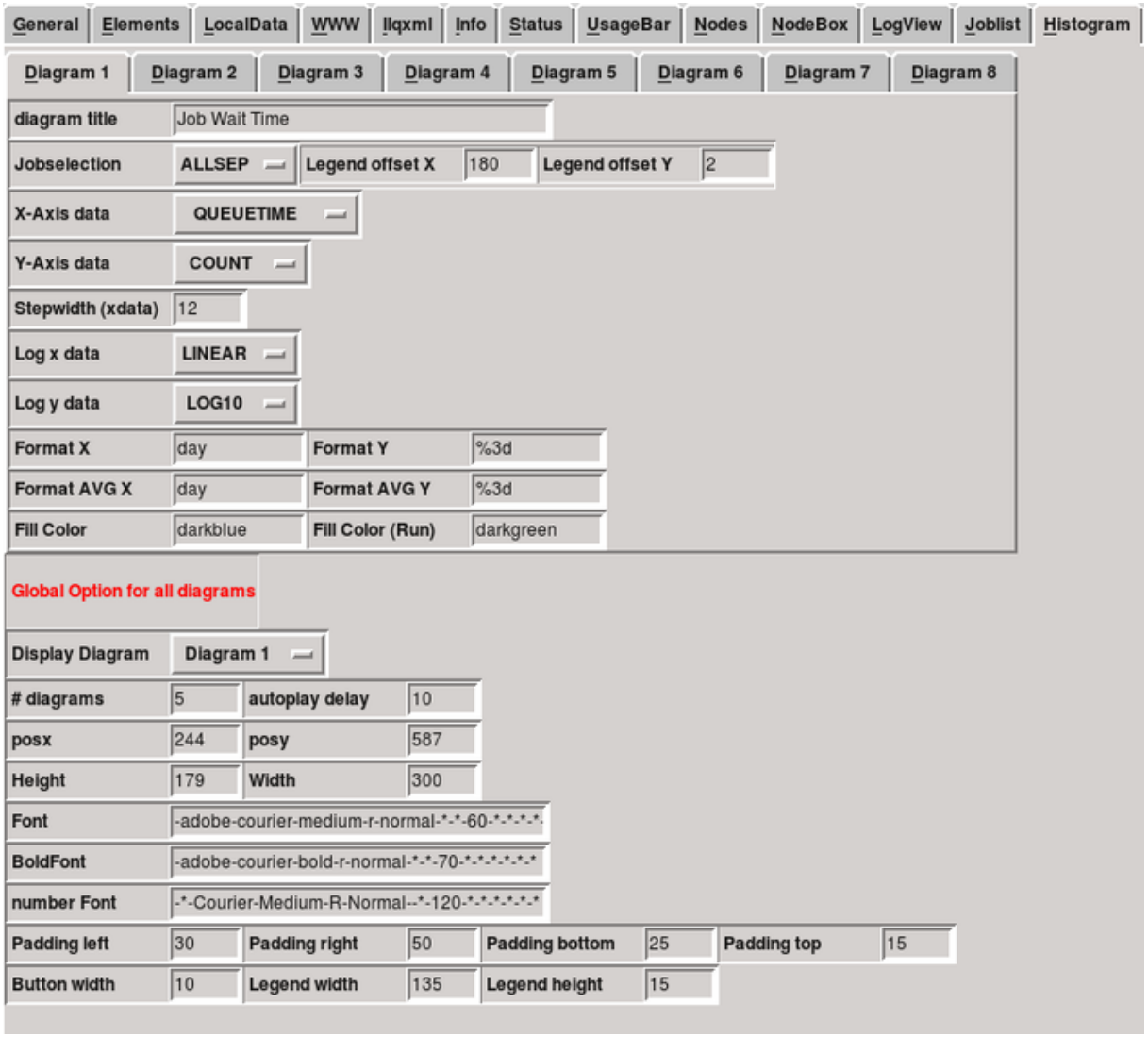
LLview Histogram options



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Histogram Options

- Each histogram shows distribution for a single job attribute, e.g. waiting time
- You can configure up to 8 histograms
- Jobs are grouped into discrete classes, y-axis shows count of jobs in each class
- Y-axis may also show number of CPUs, CPU hours or job duration
- Scaling may be linear or logarithmic
- *Auto play* is available for public display

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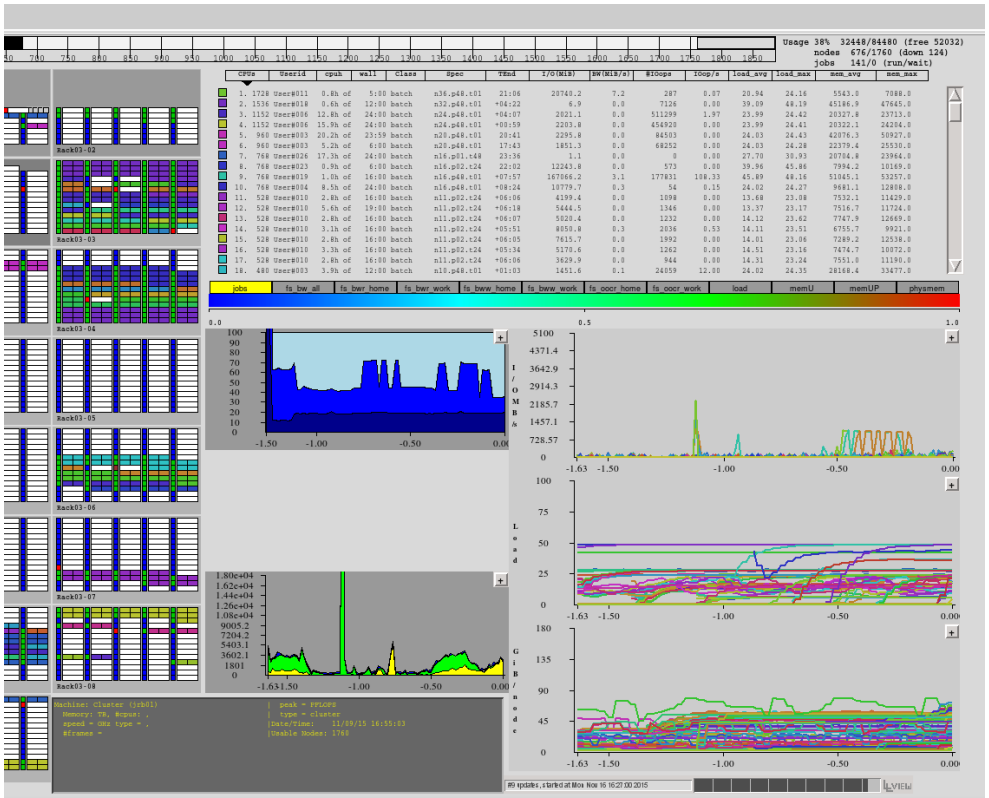
Recent and future development

- Load, Memory and I/O **profile per job**
- **Annotations** for adding texts, images and markers at any location on LLview display
- **Release** expected at the end of 2015



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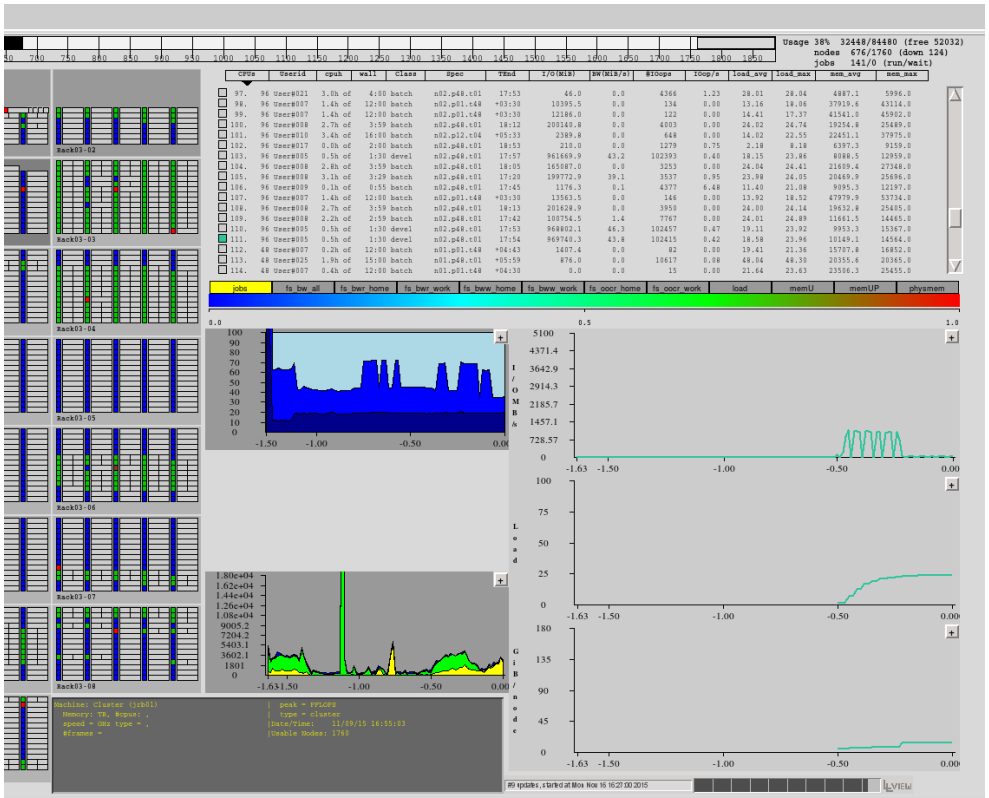

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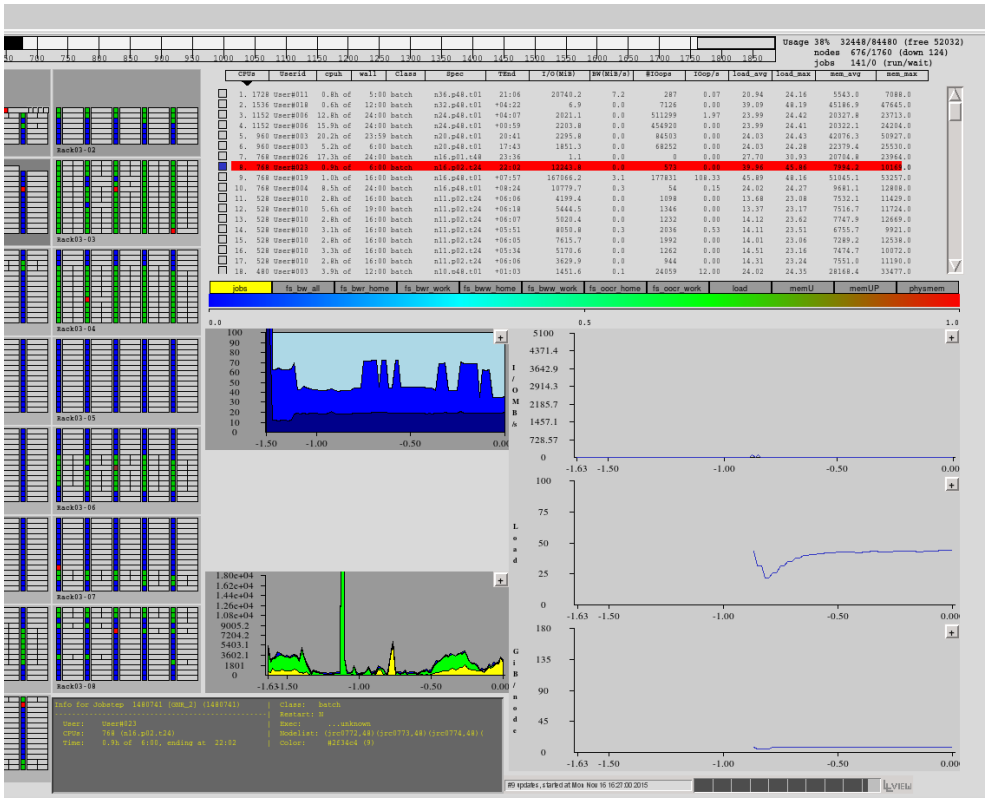

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Contact

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- **LLview** → `http://www.fz-juelich.de/jsc/llview`
- **JSC-PTP tutorials** → `http://www.fz-juelich.de/SharedDocs/Downloads/IAS/JSC/EN/PTP/JSCPTPJuqueen.html`
- **PTP Download** → `http://www.eclipse.org/downloads`